

## Chapter 10

## SPECIAL FILL AND BACKFILL

### Introduction

Special backfills play an important role in highway construction. Many times weak subgrades require special backfill to correct problems. Special backfill may also be necessary to facilitate good compaction around structures such as catch basins, manholes, pipes, or bridge end bents.

The technician will need a good knowledge of how special backfill is used for best highway performance. This chapter will discuss materials, compaction, placement, and measurement.

### **B Borrow fill and backfill....Section 211**

This work shall consist of backfilling excavated or displaced peat deposits; filling up to designated elevations of spaces excavated for structures and not occupied by permanent work; constructing bridge approach embankment; and filling over structures and over arches between spandrel walls, all with special materials.

#### **Materials.**

The material used for special filling shall be of acceptable quality, free from large or frozen lumps, wood, or other extraneous matter and shall be known as B borrow. It shall consist of suitable sand, gravel, crushed stone, air cooled blast furnace slag, granulated blast furnace slag, or other approved material. The material shall contain no more than 10% passing the No. 200 sieve and shall be otherwise suitably graded. The use of an essentially one-size material will not be permitted unless approved.

The Contractor has the option of either providing B borrow or structure backfill from a established CAPP source, or supplying the material from another source. The Contractor has the following options for supplying B borrow or structure backfill from a local site:

- (a) the establishment of a CAPP Producer Yard at the local site in accordance with 917; or
- (b) use a CAPP Certified Aggregate Technician or a consultant on the Department's list of approved Geotechnical Consultants For Gradation Control Testing.

The frequency of gradation control testing shall be one test per 2000 ton based on production samples into a stockpile or by over the scales measurement, with a minimum of two tests per contract (one in the beginning and one near the mid-point). The sampling and testing of these materials shall be in accordance with applicable requirements of 904 for fine and coarse aggregates. The Contractor shall advise, in writing, the Engineer and the District Materials and Testing Engineer of the plan to measure the material.

**Flowable Mortar Substitution.** When borrow or B borrow for structure backfill is specified, the Contractor may substitute flowable mortar in accordance with 213. However, flowable mortar shall not be placed into or through standing water, unless approved in writing.

## **CONSTRUCTION REQUIREMENTS.**

If B borrow or B borrow for structure backfill is obtained from borrow pits, their locations, depths, drainage, and final finish shall comply with the provisions for these items in accordance with 203.

If fill or backfill is within embankment limits, and if it is not required that the entire fill or backfill be of B borrow and placed as such, then that portion above free-water level shall be placed in accordance with applicable provisions of 203 and compacted to the required density.

If borrow is required outside the specified limits of B borrow, material in accordance with the specifications for B borrow may be furnished at the contract unit price for borrow; however, the quantity of borrow measured for payment outside the limits of structure backfill will not exceed the theoretical quantity of B borrow furnished.

Unless otherwise specified, all spaces excavated for and not occupied by bridge abutments and piers, if within embankment limits, shall be backfilled to the original ground line with B borrow, and placed in accordance with 211.04.

Where B borrow or B borrow for structure backfill is required as backfill at culverts, retaining walls, sewers, manholes, catch basins, and other miscellaneous structures, it shall be compacted in accordance with 211.04.

**Mechanical Compaction.** Where B borrow or B borrow for structure backfill is to be placed by mechanical compaction, it shall, unless otherwise specified, be placed in accordance with the applicable provisions of 203.23 except, if mechanical tamps or vibrators are used, the material shall be deposited in approximately 6 in. horizontal layers, loose measurement, and each layer compacted to density requirements.

**Embankment for Bridges.** When special filling is required, the embankment for bridges shall be constructed using B borrow within the specified limits shown on the plans. All embankment construction details specifically set out in this specification for embankment for bridges shall be considered in accordance with the applicable requirements of 203.

At the time B borrow is being placed for approach embankment, an earth, watertight, well-compacted dam shall be constructed in level lifts, the details of which are shown on the plans. Except as hereinafter specified for material to be used in constructing the enclosing dam, and for growing vegetation, and unless otherwise provided, the material for constructing bridge approach embankment shall be B borrow compacted by mechanical methods. If approach embankment or shoulders are constructed of material not suitable for growing seed or sod, and if one or both of these is required, then such areas shall, unless otherwise specified, be covered with a layer of clay, loam, or other approved material, which is suitable. This layer shall be approximately 1 ft thick after being compacted into place.

**B Borrow Around Bents.** When specified, B borrow shall be placed around all bents falling within the limits of the approach grade as shown on the plans. Before placing, the surface of the ground on which it is to be placed shall be scarified or plowed as directed. The embankment slope shall be 2:1 on the sides and beneath the structure, and shall be 6: 1 from the end of the bridge down to the average ground line, or it may be required to complete the approaches back to the existing grade. The enclosing dam and provisions for growing vegetation shall be in accordance with 211.06.

**Aggregate For End Bent Backfill.** When specified, coarse aggregate in accordance with 211.02(c) shall be placed behind end bents as shown on the plans. The material shall be deposited in lifts not to exceed 12 in. loose measurement, and each layer shall be mechanically compacted using a hand held vibratory plate compactor having a plate width of 17 in. or larger that delivers 3000 to 9000 lb per blow. Each layer shall be compacted with two passes of the compactor.

Prior to placing the aggregate, a geotextile in accordance with 913.18 shall be installed in accordance with 616.10.

**Unbalanced Backfill.** Unbalanced backfill will not be permitted until the concrete required to resist it is at least 10 days old or a flexural strength of 440 psi for third point loading has been attained. The unbalanced height shall not exceed 10 feet until the concrete is at least 15 days old or a flexural strength of 480 psi for third point loading has been attained.

**Spandrel Filling.** Unless otherwise specified, spandrel fills for arch structures shall be composed of B borrow. The fill shall be carried up symmetrically in horizontal layers from haunch to crown and simultaneously over all piers, abutments, and arch rings.

**Method of Measurement.** B borrow, B borrow for structure backfill, and aggregate for end bent backfill will be measured by the cubic yard as computed from the neat line limits shown on the plans, or as adjusted. If cubic yards are set out as the pay unit for B borrow or B borrow for structure backfill in the Schedule of Pay Items and if neat line limits are not specified for measurement of volume for the material, measurement will be made by the cubic yard at the loading point in truck beds which have been measured, stenciled, and approved. The B borrow may be weighed and converted to cubic yards by assuming the weight per cubic foot to be 90% of the standard maximum wet density as determined in accordance with AASHTO T 99. The material may be cross-sectioned in its original position and again after excavation is complete, and the volume computed by the average end area method. If B borrow is used for backfill in areas where unsuitable material is present or peat excavation has been performed, unless otherwise directed, the B borrow will be cross-sectioned, and the volume will be computed by the average end area method.

If the material is to be paid for by the ton, it will be weighed in accordance with 109.01 (b).

If the material comes from a wet source such as below water or a washing plant, and weighing is involved in the method of measurement, there shall be a 12 h drainage period prior to the weighing.

Geotextiles will be measured in accordance with 616.

**Basis of Payment.** The accepted quantities of B borrow will be paid for at the contract unit price per cubic yard or per ton as specified, complete in place.

B borrow for structure backfill will be paid for at the contract unit price per cubic yard, based on the neat line limits shown on the plans or as adjusted for authorized changes, provided the material comes from outside the permanent right-of-way. If the schedule of pay items does not contain a pay item for B borrow for structure backfill and it is required to backfill pipes or culverts within the project limits, a change order will be generated to establish a unit price.

B borrow material placed outside the neat lines will be paid for as borrow when such B borrow eliminates required borrow material. Otherwise, no payment will be made for backfill material placed outside the neat lines.

If material which is in accordance with the requirements for B borrow is obtained within the excavation limits of the project and is used as such, it will be paid for at the contract unit price for the class of excavation involved. No further payment will be made.

Aggregate for end bent backfill will be paid for at the contract unit price per cubic yard, based on the neat line limits shown on the plans or as adjusted by authorized changes.

Geotextiles will be paid for in accordance with 616.12.

Flowable mortar which is substituted for B borrow or B borrow for structure backfill will be paid for as B borrow or B borrow for structure backfill, respectively.

If topsoil, loam, or other suitable material in accordance with 211.06 is used for expediting the growth of seed or sod, it will be paid for at the contract unit price per cubic yard for borrow, or for salvaged stockpiled selected materials as shown on the Schedule of Pay Items, unless otherwise provided.

### **FLOWABLE MORTAR.... SECTION 213**

This work shall consist of placing flowable mortar to fill trenches for pipe structures, culverts, utility cuts and other work extending under pavement locations, to fill cavities beneath slopewalls and other locations in accordance with 105.03.

If fly ash is used as a filler and not as a pozzolanic material, it shall be in accordance with the applicable requirements of 904.01(e).

**Proportioning.** The Contractor shall submit a mix design and shall arrange a trial batch demonstration to ensure compliance in accordance with the requirements listed herein. The mix design shall include a list of all ingredients, the source of all materials, the gradation of all aggregates, the names of all admixtures and dosage rates, and the batch weights. Except for adjustments to compensate for routine moisture fluctuations, mix design changes after the trial batch verification shall be documented and justified prior to implementation by the Contractor. A change in the source of materials, addition or deletion of admixtures or cementitious materials will necessitate a new mix design. However, a new mix design will not be required for a change from one Department -approved natural fine aggregate source to another Department-approved natural fine aggregate source having the same fine aggregate gradation. The Contractor may be required to provide test data from a laboratory inspected by the CCRL, and approved by the Department, which shows that the proposed mix design is in accordance with the strength limitations.

Only the materials listed in 213.02 may be used in the flowable mortar mix designs. The proposed mix design materials and proportions shall be submitted to the Department. Final proportioning will be determined based on the approved mix design.

**Flow.** The test for flow shall consist of filling a 3 in. diameter by 6 in. high open-ended cylinder placed on a smooth level surface to the top with the flow able mortar. If necessary, the cylinder shall be struck off so that the mixture is level. The cylinder shall be pulled straight up within 5 s. The spread of the mortar shall be measured. The diameter of the mortar spread shall be at least 8 in. Minor flow adjustments may be made by making minor adjustments in the water or fly ash filler content in the mixture.

**Average Penetration Resistance.** The average penetration resistance in 14 days shall not be greater than 5,000 psi nor less than 1,200 psi in accordance with ASTM C 403.

**Mixing Equipment.** The mixing equipment shall be in accordance with the applicable requirements of 702 or 722, except that in lieu of the calibration requirements of 722.11, the mixer operator shall make delivery in a properly calibrated continuous mixer.

**Placement.** The mixture shall be discharged from the mixing equipment by a reasonable means into the spaces to be filled. The flowable mortar shall be brought up uniformly to the fill line as shown on the plans or as directed. Placing of material over the flowable mortar may commence as specified herein or as directed.

The materials shall be mixed, delivered, and placed within 2 1/2 h.

Voids beneath reinforced concrete bridge approach pavement shall be filled as directed. Holes shall be drilled at locations as directed and in accordance with 612.04. The flowable mortar shall be placed until the bridge approach pavement has uniform support by means of completely filling all voids. During the filling operation, plugs may be required. Plugs shall be installed to confine the mortar as directed. The bridge approach pavement shall not lift off the bridge seat.

**Limitation of Operations.** The flowable mortar shall not be placed on frozen ground. Flowable mortar shall be protected from freezing until the material has set.

The mortar shall not be subject to load nor disturbed by construction activities until an average penetration resistance has been achieved for a minimum of three readings of not less than 70 psi for portland cement concrete pavement or 1,200 psi for HMA pavement. Penetration resistance shall be determined in accordance with ASTM C 403.

**Method of Measurement.** Flowable mortar will be measured by the cubic yard as computed from the neat line limits shown on the plans, or as adjusted. If neat line limits are not shown on the plans, the volume in cubic yards of flowable mortar furnished and placed will be computed from the nominal volume of each batch and a count of the batches. Unused and wasted flowable mortar will be estimated and deducted. Drilled holes will be measured by the number of holes drilled.

**Basis of Payment.** The accepted quantities of flowable mortar will be paid for at the contract unit price per cubic yard furnished and placed.

Filling voids beneath concrete bridge approach pavement will be paid for at the contract unit price per cubic yard for flowable mortar. Holes drilled in the pavement will be paid for at the contract unit price per each.